

SAE COLLEGIATE DESIGN SERIES

2015 season recap

BEST BOOTH

University of Puerto Rico-Mayaguez team wins Student Exhibit Competition

Stemming the STEM crisis

Getting through to kids early



A video contest organized by OESA and SAE International, with the support of Deloitte

Student Teams – Submit Your Video Now

What makes the automotive industry a “cool” industry in which to work?

Deloitte.

This contest invites students who participate in the SAE Collegiate Design Series™ competitions to create and submit videos highlighting the diverse aspects of the automotive industry that make it an attractive or “cool” industry in which to work. Cash prizes are offered to the SAE CDS teams with the top three videos.



The need for a highly skilled and technical workforce has never been greater, and the industry offers a myriad of opportunities for ambitious students who desire a challenging career in a fast-paced industry.

SAE CDS team video submissions of no more than two minutes in length can now be uploaded to the contest website. Two rounds of judging will rate the selected videos on a set of criteria including message, accuracy and creativity. For the final round of judging, the three videos with the highest ratings will be viewed and voted on by attendees at the OESA Annual Outlook Conference on Nov. 10, 2015. Winners will be announced at the conclusion of the conference.



**Discover what SAE CDS students
think...view their videos at
<http://bit.ly/1xC8TEj>**

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Issue 4

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CDS COMPETITION STIFFER THAN EVER

As "The Magazine for Student Members of SAE International" did last year, *MOMENTUM* again this year is dedicating much of the September issue (pages 4-12) to recognition of winners from the past SAE Collegiate Design Series (CDS) season. Finishing ahead of all other teams at a CDS event is quite an achievement—especially so because, as **SAE International** CDS Manager Bob Sechler notes, more and more university teams are trying to get into them. CDS competition is stiffer than ever.

"Demand for CDS events continues to grow, and we have now established waitlists for each of our events to fill vacated slots," he said. "Every single slot in eight of the competitions was filled in 2015. But it's our goal to make these educational opportunities available to as many young engineers as possible."

There's great progress to report in that area, with more students per team. So despite being almost at the saturation point regarding the number of teams that can be accommodated in CDS, the number of student participants grew significantly in 2015—up almost 500 to 8608, according to Sechler. That figure is for the number of team members and faculty on site for the 10 SAE CDS competitions (not including Formula Hybrid, which is a CDS-affiliated competition run by Dartmouth College).

I think I speak for all of SAE International staff and volunteers in saying it's truly gratifying for us to witness the high levels of enthusiasm and intelligence expressed by the increasing number of students participating in CDS events. It's almost too cliché to write it, but we really do think all of you are winners. The technical skills you are developing via CDS are impressive. So are the time-management and interpersonal team skills you are cultivating. The future of mobility engineering is secure in your capable hands.

But let's not get ahead of ourselves. SAE International hopes to see CDS participation levels increase even more for 2016. We're hoping you can help. See page 3 for a short article about incentives for signing up new SAE student members and getting them involved in CDS.

Thanks for making CDS the great program it has been to date, and good luck in the coming season.



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SAE International sections are local units comprised of 100 or more SAE International members in a defined technical or geographic area. The purpose of local sections is to meet the technical, developmental, and personal needs of the SAE members in a given area. There are more than 42 established sections in the United States and Canada, as well as international sections/groups and SAE International affiliate organizations. For more information, please visit www.sae.org/sections.

Collegiate chapters at SAE International

Collegiate chapters are a way for SAE International student members to get together on their campus and develop skills in a student-run and -elected environment. Student members are vital to the continued success and future of SAE. While your course work teaches you the engineering knowledge you need, participation in your SAE collegiate chapter can develop or enhance other important skills, including leadership, time management, project management, communications, organization, planning, delegation, budgeting, and finance. For more information or how to find your local chapter, please visit <http://students.sae.org/chapters/collegiate/>

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- Become a *MOMENTUM* contributor by submitting an article. Add that achievement to your resume. Send an email to momentum@sae.org expressing your interest in contributing.
- Spread the word about this magazine to other engineering students and faculty, and encourage them to join SAE today by visiting www.sae.org/membership.

BUCKEYES SCORE BACK-TO-BACK WINS IN ECOCAR COMPETITION

A team of students from **Ohio State University** in June was named winner of Year One in the four-year EcoCar3 competition sponsored by the **U.S. Department of Energy**. An OSU team won Year Three of the three-year EcoCar2 competition last year. In all EcoCar competitions, **General Motors** provides each team with a car to modify for reduction in energy consumption, well-to-wheel greenhouse gas emissions, and tailpipe emissions. For EcoCar



Some members of the 40-strong Ohio State University EcoCar3 team gave a “trade show” presentation as part of the Year One event, which took place in Seattle during summer 2015.

3, a 2016 **Chevrolet Camaro** is the subject vehicle. Year One of EcoCAR 3 emphasizes the use of math-based design tools and simulation techniques. In years two, three, and four, students will rebuild the vehicle based on their new architecture and continue to refine, test, and improve the vehicle's operation.

STUDENTS RACE FOR COVETED FORMULA ONE INTERNSHIP WITH INFINITI

Of 1146 U.S. undergraduates who entered a competition to spend a one-year paid internship under the **Infiniti Performance Engineering Academy**, 12 are on their way to the world finals. And of those 12, 6 are involved in Formula **SAE**: Alex Allmandinger, **University of Illinois**; Sabre Cook, **Colorado School of Mines**; Mindy McCord, **Montana State University**; Daniel Riggs, **Michigan State University**; Keaton Zahorsky, **University of Oklahoma**; and Nicholas Venditti, **Rochester Institute of Technology**. The single U.S. winner will spend half the time working alongside engineers from Infiniti, and the other half with **Infiniti Red Bull Racing's Formula One** engineering team—both in the U.K. Four students from other countries will get similar internships.

‘TALENT PIPELINE’ PART OF LAWRENCE TECH-JOHNSON CONTROLS PARTNERSHIP

A major automotive supplier has opened a vehicle-energy-storage lab at **Lawrence Technological University** as part of a year-old partnership. Students will work alongside technical experts at the **Johnson Controls** Vehicle Engineering Systems



For a video detailing the partnership between Lawrence Tech and Johnson Controls, go to <https://www.youtube.com/watch?v=c76lXXkkJFM&feature=youtu.be>.

Laboratory, which will include a vehicle dynamometer to help researchers understand how best to manage battery energy and power transfer in the vehicle. The partnership will provide “a strong talent pipeline for scientists and engineers interested in careers that will shape the way we drive our vehicles and use natural resources,” said MaryAnn Wright, Vice President of Engineering and Product Development for Johnson Controls Power Solutions. She is a Lawrence Tech trustee.

PRIZES FOR SIGNING UP TO BE SAE INTERNATIONAL STUDENT MEMBERS

SAE International collegiate chapters are encouraged to beef up their student membership. Students who sign up by Sept. 30 for SAE Student Membership will automatically be entered in a drawing to win a free SAE Book Bag. The SAE collegiate chapter that recruits the most new student members will receive a \$400



Ryan Perry (kneeling front left) and Will Sahutske (kneeling front right) spearheaded formation of a Formula SAE team from scratch at Central Michigan University for the 2014-2015 year. Shown here at the May 2015 FSAE Michigan event is the team they recruited. (Photo by Patrick Ponticel)

Visa gift card for their chapter activities. By signing up now and renewing each year, you will be current for SAE Collegiate Design Series competitions each spring that you participate.

UMICH-ANN ARBOR TEAM TAKES HOME BAJA SEASON'S IRON TEAM AWARD



The University of Michigan-Ann Arbor team completed the three-race Baja SAE season with two first-place finishes and a second-place finish. (Photo courtesy of Michigan Baja Racing)

COMING INTO THE FINAL EVENT of the 2015 Baja SAE season with a team mentality of “fast don’t lie,” the **University of Michigan-Ann Arbor** raced to victory at Baja SAE Oregon MAY 27-30 and in the process captured the 2015 Mike Schmidt Memorial Iron Team Award for the highest normalized point total across all three Baja SAE events.

“We knew that it was going to be a very close battle with **Cornell University** after it had scored higher than us in the second competition [Baja SAE Maryland, May 7-10],” said Michigan Baja Racing team captain Jason Willig, a junior mechanical engineering major. “So we prepared ourselves for the Presentation events and made sure we had sufficient driver practice and training for the courses we anticipated seeing, especially the Rock Crawl.”

Earlier in the season, Michigan Baja Racing took home first place overall at the season’s inaugural competition, Baja SAE Auburn, held April 9-12.

At Baja SAE Oregon, Michigan Baja Racing placed first in the Endurance, Hill Climb, and Acceleration events on its way to the overall victory.

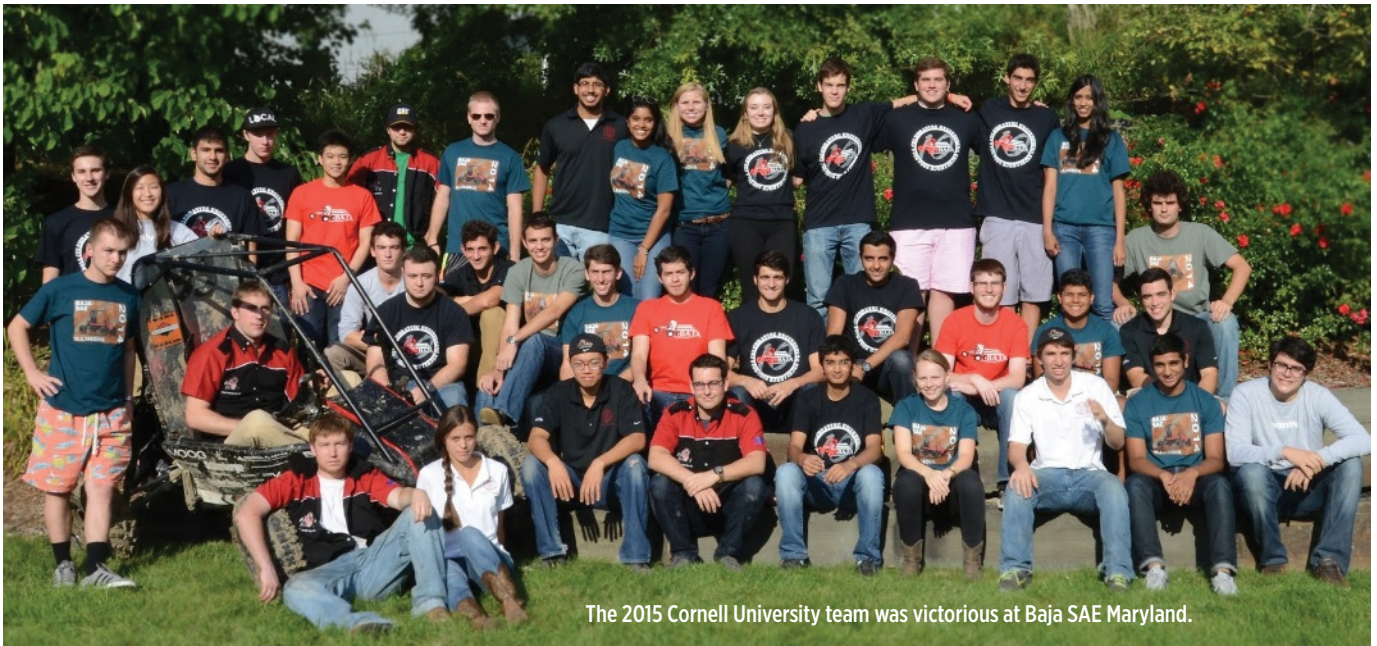
For the Hill Climb event at Baja Oregon, Michigan Baja Racing had two priorities: observe a few teams first in order to get its sights on a good line up the hill, and second, “to go before the track got torn up from the other cars,” Willig said. “This was our endurance driver’s second year of driving this event for us, so his experience was a key factor in the victory. He is very consistent throughout the whole four-hour race,

and that is key to knowing that our car is performing up to its full potential.”

The Baja SAE Oregon competition attracted 95 teams from the U.S., Canada, India, Mexico, Venezuela, South Korea, and the United Arab Emirates. **Oregon State University** finished second at Baja SAE Oregon, followed by **Rochester Institute of Technology (RIT)**, **Cornell**, and **Cal Poly**.

All three of those teams had outstanding seasons, and along with Michigan Baja Racing were the only teams to net top 10 finishes in every Baja SAE competition this year. RIT finished no worse than 10th in any of the three competitions. Oregon State finished no worse than sixth, with two top-fives. Cornell did even better, winning one competition with the Baja SAE season’s highest score (977 at Baja SAE Maryland), finishing second in another, and fourth in another. If not for Michigan Baja Racing’s outstanding season, Cornell would have won the Iron Team Award.

Michigan Baja Racing knows what it’s like to finish as Iron Team runner-up, achieving that distinction last season. Cornell won the trophy in 2014. To knock off its rival in 2015, Baja Racing Michigan took an all-encompassing approach to earning points.



The 2015 Cornell University team was victorious at Baja SAE Maryland.

"All of our changes were data-driven, but we made sure that they could directly correlate to points we thought we could gain in competition," said Willig. "This year, we made Design finals [an event worth up to 150 points] at each competition—a goal we had set at the beginning of the year. We placed in the top 10 in the dynamic day scoring at each competition, and in the top 10 of Endurance [worth up to 400 points] at each competition. The main key, though, was ensuring the car's durability and giving ourselves extensive tuning time. We had five full weeks of vehicle validation testing and tuning before the first competition."

A new suspension and transmission setup helped the team realize those goals.

"This year's vehicle featured an unconventional rear suspension that used the driveshaft as an axially loaded suspension member, increasing ground clearance,

"The main key, though, was ensuring the car's durability and giving ourselves extensive tuning time."

Jason Willig, University of Michigan-Ann Arbor

decreasing component count, and creating favorable changes to the behavior of the vehicle," Willig explained. "Another engineering highlight is our entirely custom continuously variable transmission, which we spent a lot of time tuning to get the fastest vehicle possible with the best shifting characteristics. Overall, our vehicle weighed 285 lb (kg), which was the lightest car at competition."

For its part, Cornell shed 299 lb (kg) from its car for the 2015 season. "We are the only team that builds an

all-aluminum suspension, which saves us 6 pounds over steel equivalents," said Noah Wade, a senior applied and engineering physics major and Cornell Baja team leader. "We run custom brakes and a custom CVT—all designed to give us increased performance and less weight than what most other Baja cars are running."

The Budds Creek course for the Baja SAE Maryland competition presented a different challenge to teams than some of the previous competitions, favoring large hills over cumbersome obstacles. Cornell won that competition, finishing ahead of University of Michigan-Ann Arbor, **École de Technologie Supérieure**, **Universidade Federal de Pernambuco**, and **Polytechnique Montréal**.

"This event was very high-speed compared to others, which made braking and CVT tuning more important," said Brent Carlson, a fellow team leader and Cornell's main endurance driver. "Big hill climbs on every lap also emphasized CVT tuning. This event was much less about trying to break your car and more about how well the vehicle was tuned."

This year, Cornell changed from a spool type to a fully adjustable limited-slip differential, giving it better maneuverability. Other changes included the installation of a cutting brake system and custom fixed calipers and master cylinders, which "worked perfectly on the course that was heavily dependent on braking," noted Carlson.

The Baja SAE competitions, like all of those in the SAE Collegiate Design Series, are designed as learning experiences that will help students get jobs and do well at them.

"We get this incredible opportunity to drive wheel-to-wheel with other competitors from all over the world," said Jeremy Croom, a senior in mechanical engineering who is Captain and Endurance event driver for the **Auburn University** War Eagle Motorsports team. "Even better, my participation helped me to secure a job [with the Naval Surface Warfare Center in Panama City, Fla.] after I graduate. The recruiter liked my involvement with this event. It demonstrated my commitment to the team, along with the knowledge and skills I acquired during this experience." ■



Team members from Warsaw University of Technology pose in celebratory fashion with their Aero Design entries.

GEORGIA TECH AND WARSAW UNIVERSITY WERE DOUBLE-WINNERS AT SAE AERO DESIGN COMPETITIONS

University of Akron and University of Cincinnati were the other winners at the twin 3-class competitions, the former setting a record in the process.

GEORGIA INSTITUTE OF TECHNOLOGY took home two first-place Class trophies at the SAE Aero Design East competition held in March, and **Warsaw University of Technology** accomplished the same feat at the SAE Aero Design West competition in April.

At the Aero Design East competition in Lakeland, Fla., Georgia Tech won the Micro Class and the Advanced Class. The **University of Cincinnati** won the Regular Class. Lockheed Martin and the Florida Air Museum were host to 75 teams that made the trip to that first of two Aero Design contests held as part of the SAE Collegiate Design Series.

The Aero Design competition has been designed to provide exposure to the kinds of situations that engineers face in their real-life work environment. The specific purpose of the Regular Class is to help student teams develop a fundamental understanding of flight. Advanced Class requires teams to have a systems approach to the design while integrating several disciplines: aeronautical, mechanical, electrical, and

computer engineering. Micro Class teams are required to make trades between two potentially conflicting requirements: carrying the highest payload fraction possible while simultaneously pursuing the lowest empty weight possible.

The Micro Class was really challenging at Aero Design East, said Georgia Tech sophomore Matt Warren. "[Our entry] had to fit into a tube that was six inches wide, which is very small. We made it harder by deciding that our tube would be just six inches long."

After competing among themselves for the best design concept, the team selected Warren's design, a 1.3-lb (0.6-kg) Rogallo wing hand glider. It was judged on the weight of the payload it could carry.

The Georgia Tech team also placed first in the Micro Class subcategory of Design Report and second place in Presentation. The university's Advanced Class entry, in addition to placing first overall, won first place in Target Accuracy and second place in Presentation.

On its way to winning first place overall in the Regular Class, the University of Cincinnati placed first in the subcategory of Oral Presentation. It placed second in Maximum Payload and fourth in Design Report. Teams in this class were tasked with designing an airplane to carry as much payload as possible within certain design constraints including an



The University of Cincinnati AeroCats team is composed mainly of seniors majoring in aerospace engineering.



The Georgia Tech team had one of its most successful Aero Design experiences ever, capturing two Class wins. Some of the 35 team members are shown here with their “metal” for those Class victories and for other distinctions at SAE Aero Design East 2015.



The record-breaking Zips Aero team from the University of Akron.

electric motor that produced no more than 1000 W. The Cincinnati team came within less than 1 lb (0.5 kg) of winning the Max Payload subcategory, but scored well enough in the other subcategories to take home gold.

At the April 24-26 SAE Aero Design West competition, three teams from Poland took four of the six top three places in the competition’s three Classes. Warsaw University of Technology (WUT) placed first in the Micro and Regular Classes, **Poznan University of Technology** took second in the Micro Class, and **AGH University of Science and Technology** placed second in the Advanced Class.

In addition to winning the two Classes, the WUT team also won first place in the Max Payload events in both the Regular and Micro Classes. Students from WUT’s Power and Aeronautical Engineering program have been taking part in SAE Aero Design contests since 1991.

The **University of Akron (UA)** was the big winner among American teams, taking first place in the Advanced Class and third in the Regular Class. One of the events within the Advanced Class is Drop Accuracy in which 3.0-lb (1.4-kg) sandbags are dropped onto ground targets from 100 ft (30 m) in the air. UA’s Advanced Class plane, “Thunder,” features an onboard camera and sensors, which transmit data including airspeed and altitude to the ground station. In order to release the sandbag at the right moment, a co-pilot monitors camera and sensor inputs to instruct the pilot when to drop the bag.

With a better camera and improved camera feed in tow this year, the UA team, called Zips Aero, managed to land the sand only 87 in (2200 mm) from the target, improving upon last year’s 95-in (2410-mm) record-setting drop. According to electrical engineering student and team co-captain Elizabeth Hammell, the next closest team dropped a bag more than 20 ft (6 m) from the target.

Mechanical engineering senior Evan Heinrich led the team in aircraft design, focusing on a brand new fuselage with aerodynamic fixtures to reduce drag as part of his senior design project. “We made the wing much stronger this year,” he said. “Plus, it was designed to handle crosswind better. Our goal was to build a more stable, aerodynamic plane.” ■

WEST COAST TEAMS WIN 2 OF 3 FORMULA SAE EVENTS

Oregon State captures its fifth crown while San Jose State enjoys its first overall victory and UPenn tops the electric field.

FEATURE



San Jose State University's Spartan Racing team got its first-ever overall Formula SAE victory in 2015.

THERE ARE A LOT of “usual suspects” at a Formula SAE Michigan competition: One or more of the top teams is usually from a German-speaking country. The victor is usually **Oregon State University (OSU)**. And there is usually a large margin of victory.

Only one of the usual suspects, “large margin of victory,” was missing from the lineup for the partly rainy affair that was held May 13-16 at Michigan International Speedway (MIS) in Brooklyn, Mich. OSU did indeed capture the 2015 FSAE Michigan title (its fifth in the past six years), but by a very small margin. Usually measured in dozens, the point spread between first and second was in the single digits.

Always a threat to win, **Graz Technical University (TU Graz)** of Austria came close to doing just that. But it was the **University of Florida**, which has been steadily moving up the FSAE Michigan score sheets over the past six years, that nearly pulled off the upset. Gator Motorsports finished with 844.8 points (out of a possible 1,000), 3.3 behind

OSU and 23.4 ahead of third-place TU Graz. Gator Motorsports placed first in one event, Acceleration, edging out a very strong **National University of Singapore** team by just 0.001 s. It placed second in both the Endurance and Design events.

When *Update* came across Noel Thomas, Team Captain for Gator Motorsports, at the competition, he was in a very upbeat mood—understandable because his team was in first place at the moment. When asked about the big changes from the 2014 car to the 2015 car, he noted that 2015 is the first year in which the team is using aerodynamic wings on its car. Incorporating wings was a major undertaking, he explained, and it had a cascading effect—for example, the brakes had to be beefed up because of the extra downforce produced by the wings.



There is a lot of personnel horsepower behind the Oregon State University FSAE squad.



Penn team members who traveled to the Formula SAE Lincoln competition pose with their seven event trophies and the large overall winner's cup.

The following words written on the back side of the team's car are an indication of what its engineering design priority was: "May the downforce be with you."

A new air intake design was another major undertaking for the 2015 Gator Motorsports team.

(For more images and a longer article on the FSAE Michigan event, see the [July issue of Update.](#))

FSAE LINCOLN

The **San Jose State University** (SJSU) Spartan Racing team came into FSAE Lincoln following a 37th-place overall finish at Formula SAE Michigan (May 13-16) but riding the momentum of first- and fifth-place finishes in the Skid Pad and Autocross events, respectively.

"The Michigan competition is always great structured preparation for Lincoln," said SJSU Chief Engineer Ryan Sharp. "It has been beneficial since the first year we attended in 2011, not only for vehicle and driver practice, but also as additional race team preparation. The win in skid pad and fifth-place autocross score further proved that we had built a strong car."

"One week of testing is worth more than a week of design."

Eric Miller, San Jose State University

A connecting-rod-related engine failure on the first lap of the FSAE Michigan endurance competition required an engine replacement for FSAE Lincoln.

"We had brought a spare engine with us to competition, so we knew we would be prepared to swap the motor and get back to testing once the car returned from Michigan," Sharp said. "However, what we didn't see coming was that our crate with tools and the spare engine would be delayed by four days. This left us with a car sitting in the shop without an engine and down one weekend of testing leading up to Lincoln. Fortunately,

our powertrain team swapped the engine with great speed and attention to detail. This had us prepped and ready for two testing weekends."

SJSU trimmed 27 pounds (to 434) from its fifth-place 2014 FSAE Lincoln vehicle and focused on lowering the center of gravity (CG) heading into the 2015 competitions. In an email to *Update*, the team noted that "every time a component was mated in CAD, we'd ask ourselves, 'But what if it could be lower?' Moving to front pull-rod suspension, lightening the rear wing, and dropping the engine a full 1.5 inches helped drop the CG from 11.2 inches to 9.6 inches."

The goal again next year will be to trim the car's design and build period to allow even more testing time.

"One week of testing is worth more than a week of design," said team member Eric Miller.

(For more images and a longer article on FSAE Lincoln, see the [August issue of Update.](#))

FORMULA SAE ELECTRIC

The **University of Pennsylvania** took top honors in the Formula SAE Electric competition, which was held concurrently with the FSAE Lincoln competition.

At FSAE Electric, even getting on the track is an accomplishment. Most of the 20 electric racing teams in attendance were disqualified during the event's exacting technical inspections.

Last year's Penn Electric Racing car, REV-0, met with that fate. Drawing on lessons learned, the team put a year's worth of fine-tuning into its successor, REV-1.

"Last year's experience showed us what it actually takes to build a competition-ready FSAE Electric car," said Parth Patel, team member and electrical engineering major. "EVs are difficult for a new team, but we needed to take what we learned on how to build a rules-compliant EV with REV-0 and fast-track it to build REV-1. The experience with REV-0 trained our members with the fundamentals of the EV powertrain including designing an accumulator, working with three-phase ac motors and motor controllers, designing custom circuit boards, and writing robust software."

As a result of its hard work, REV-1 took first place among electrics overall, winning seven of the eight events: Design, Presentation, Acceleration, Skid Pad, Autocross, Endurance, and Efficiency. The acceleration test was one of the team's strongest suits; beyond taking first among electrics, REV-1 would have beaten all but three of the gas-powered cars.

"We have several features in place for acceleration," Patel said. "This includes a quick-changeable rear sprocket to adjust gearing and software implemented field-weakening of the motor. We developed a motor model and determined how and when to apply field-weakening, a technique for over-driving our permanent magnet ac motor beyond its normal operating speed."

(For more images and a longer article on FSAE Electric, see the [August issue of Update.](#)) ■



The Wisconsin-Madison team and its eight trophies. The BASF-sponsored Best of the Best award (the one being held in the middle of the photo) has special meaning, said team captain Jennifer Bartaszewicz (sitting, left) because “in BASF’s eyes we had a complete package with advanced engine technology and emissions strategy as well as strong technical paper and presentation, all backed up by performing well in the dynamic events.” (Photo by Weston Hartman)

THE UNIVERSITY OF WISCONSIN-MADISON took home the **MacLean-Fogg** traveling cup for winning the Internal-Combustion Class of the 2015 SAE Clean Snowmobile Challenge held in March at **Michigan Technological University’s** research center in Houghton, Mich. In the new Diesel Utility category, **North Dakota State University** placed first. And having traveled over 27 hours for the competition, a Finnish team of students from **Lapland University of Applied Sciences** celebrated their first year as the top Zero-Emissions team.

The Clean Snowmobile Challenge pushes teams to design, build, and test cleaner, quieter snowmobiles. A record-setting 11 teams completed the endurance run, which historically winnows out half the competition. Once the teams have passed inspection, which is overseen by professional engineers, they then compete in a long-distance run, emissions and noise tests, handling, acceleration, and technical presentations.

“We came in not knowing how we were going to do,” said Jennifer Bartaszewicz, team captain for the University of Wisconsin-Madison. “Throughout the week we started feeling more confident, but we seemed neck and neck with other teams.”

The challenge was exceptional this year, with the most participants and successful sleds competing in events. Michigan Technological University has hosted the competition for 13 years at its Keweenaw Research Center.

The lab emissions test tends to be the most nerve-wracking for the students. The teams’ sleds are partially disassembled and hooked up to equipment that reads the engine’s force and the chemicals coming out of the exhaust. To do so, the lab volunteers go full throttle and push the snowmobile to its max. Sometimes the engines get red hot, and the test is commonly the only event with serious fire danger.

“We want to challenge students to create better, cleaner, and quieter sleds,” said volunteer Sean Egmon, the Director of Services for **AVL North America**, which oversees the emissions test. “It’s not easy, but

UW-MADISON TOPS IC ENGINE FIELD AT SAE CLEAN SNOWMOBILE CHALLENGE

some of these teams were innovative and really rose to the occasion.”

Several other universities made noteworthy modifications that won awards for their internal-combustion sleds.

The **University of Idaho** team won the best engine design award for how it addressed mechanical resonance and implemented an exhaust gas recirculation system.

The **University of Minnesota-Duluth** was recognized for its exhaust gas recirculation system and water breach dynamometer—winning the team an innovation award. These same design elements won them an award for being the technology most likely to be manufactured.

“...some of these teams were innovative and really rose to the occasion.”

Sean Egmon, AVL North America

The diesel class was a new category this year. “Diesel sleds have different characteristics than gasoline sleds, so it makes sense to have a separate category,” said Travis Sims, a member of the winning team from North Dakota State University. “They are for hard work versus performance.”

Lapland University picked up wins in six subcategories, helping it win the overall Zero-Emissions Class by a large margin. ■

UNIVERSITÉ LAVAL REPEATS AS SAE SUPERMILEAGE CHAMP



Université Laval overcame a nagging short-circuit problem to beat the field by a large margin at SAE Supermileage.

A VETERAN TEAM from the Université Laval dominated the field at the 2015 SAE Supermileage competition held June 4-5 at Eaton's proving grounds in Marshall, Mich. Eaton is the principal Supermileage sponsor and has hosted the competition since its inception in 1980.

Brigham Young University came in a distant second, **Northern Illinois University** third. Laval's victory was its second in a row and fifth in the past ten years. Although it won the competition by a large margin, Laval's 2015 victory didn't come easy.

The Laval team's engineering manager, Maximilien Fecteau, told *MOMENTUM* that the key to victory "is to never give up. We had a first run that was not good enough for us to win first place. Then we had four runs that we didn't finish. Every time we went on the track, we'd complete maybe one turn and the car was back in the truck and towed off the track. That was really hard to see, every run failing."

Finally, though, after several hours, the team was able to fix a hard-to-detect short-circuit problem that kept shutting down the battery. Three consecutive runs were lost to that problem. In the next run, a piece of foam came loose and was rubbing against a wheel. The driver decided to end the run rather than risk damaging the car. The next run, its fifth, was when the team hit the jackpot, scoring 2,098 mpg.

Brigham Young's best run was 1244 mpg, and Northern Illinois' 1057 mpg. No other team broke 1,000 mpg.

Several teams bettered Laval in the only other scoring category, Design Report. The **University of South Alabama** won that static event

with 430 out of a possible 450 points, followed by **Penn State-Behrend** and **University of California-Los Angeles**. Laval tied for sixth.

Jim Gluys, Eaton Engineering Specialist for Mechanical Products, serves as the Supermileage Event Manager for Eaton. He said the 2015 version of Supermileage was most notable for the unusually large percentage of teams that passed technical inspection: 23 out of 24. Only teams that pass may go on to compete in the two aforementioned scoring events.

All vehicles, whether three- or four-wheeled, were required to use one of two specified Briggs & Stratton single-cylinder engines for propulsion (only one, the Junior 206, will be used beginning in 2016, according to Gluys). Batteries may be used for ancillary functions. Teams are encouraged to modify the engines to minimize fuel usage. Briggs & Stratton provides engines to the teams below cost.

Eaton's proving grounds track is a 1.6-mi oval, and to achieve a "run" a team must complete six laps. Teams have the opportunity to complete several runs. Gluys noted that while Université Laval won the Dynamic event for highest fuel economy, the Brigham Young car proved to be more reliable on the track. It completed five runs—each over 1,000 mpg—compared to only two successful runs by Laval. For its excellence in that regard, Brigham Young won the Endurance award, qualification for which requires at least four runs.

Brigham Young also won the Best Design Execution award. That one was worth \$500, to go along with \$500 for its Endurance award and \$1200 for its second-place overall finish in the competition.

Participating in the judging for the Best Design Execution award was an Eaton engineer who previously had participated as a student in SAE Supermileage, noted Gluys.

Eaton's involvement in SAE Supermileage marries well with the company's effort to develop products that improve fuel economy. "We're also very interested in continuing to develop technical talent for industry overall. We see Supermileage as a real building block—helping students take what they learned in the classroom and putting it into application in an activity where the answer is not in the back of the book," said Gluys.

In addition to allowing use of its proving grounds for the competition, he said, Eaton offered each team the opportunity to take up to \$500 worth of products from its **Bussman Products** unit.

One of the volunteers at SAE Supermileage was a former participant in the competition. Sarah Norris now works for Eaton as Senior Engineer, Commercial Vehicle Electrical Controls. One of several former Supermileage competitors that Eaton has hired, Norris at this year's event served as a judge for the Best Design Execution award and also spoke to the students as a group about, among other things, how much emphasis she put on Supermileage experience in marketing herself to potential employers. ■



The record-breaking University of Waterloo team. (Photo by Misha Krutiy)

TEAM FROM THE UNIVERSITY OF WATERLOO SETS RECORD IN WINNING FORMULA HYBRID COMPETITION

THE GOAL was taking home the first-place trophy. Setting a record of 33 laps in the endurance category was icing on the cake for the **University of Waterloo** as it captured the Formula Hybrid crown for the Hybrid Class in late April at New Hampshire International Speedway in Loudon.

Formula Hybrid features high-performance hybrid and electric race cars built by teams of undergraduate and graduate engineering students competing in several static and dynamic events. In the Endurance event, a specific amount of fuel is allocated for each entry, and the team that covers the most ground wins the event. It is by far the most heavily weighted event in the overall competition.

Formula Hybrid is run by the Thayer School of Engineering at **Dartmouth**, but grew out of—and is still considered part of—**SAE International Collegiate Design Series**. Many CDS rules and procedures are used.

Coming in second in the Hybrid Class at Formula Hybrid was **McMaster University**, and placing third was the **University of Victoria**.

Winning first place in the Electric Class was **Tufts University**, followed by **Carnegie Mellon University** and the **Georgia Institute of Technology**.

Key to Waterloo's winning performance was an electrical system completely redesigned because of reliability issues during past competitions. "Our electrical team is what provided us with cutting-edge features, such as a custom battery management system, and new vehicle

and driver control units," explained Rishi Chatterjee, a second-year mechanical engineering student who serves as the business lead for the team. "Complementing those design changes, our mechanical team implemented various weight reduction techniques in components throughout the vehicle."

Vehicle weight was decreased through innovative designs, such as a carbon-fiber accumulator enclosure and a new lightweight differential designed by team members Ping Cheng Zhang and Jacob Van Dorp as part of their fourth-year mechanical engineering capstone design project. The weight reductions allowed for more batteries to be added, which in turn increased the vehicle's power output and efficiency.

Fueled by their recent victory, the team's 38 members are already thinking about next year's race car.

"The focus for 2016 will be designing and ultimately implementing state-of-the-art systems such as in-hub motors, custom motor controllers, a larger-capacity battery pack, and a more refined vehicle," Chatterjee said. ■

SAE STIRS PASSION AT PUERTO RICAN UNIVERSITY



“SAE UPRM (**University of Puerto Rico-Mayaguez**) BROUGHT ME THE OPPORTUNITY to find my passion for the automotive industry,” said SAE UPRM chapter member Daniel Castro. “Thanks to its SAE Collegiate Design Series teams, workshops, and other opportunities to obtain experience and professional growth, I am now a leader among my peers.”

That’s just the kind of impact on a young adult for which SAE International is purposed. The rewards for participating in chapter activities are plentiful, and in Castro’s case they include, among other things, acceptance of a \$1,000 contribution to the chapter from Eaton in honor of the UPRM’s outstanding student exhibit at the recent **SAE 2015 World Congress** in Detroit.

“...our chapter has grown to be the most important, and most successful, engineering organization on campus.”

Daniel Castro, University of Puerto Rico-Mayaguez

SAE Congress-goers have some questions for Puerto Rico–Mayaguez SAE Student Chapter members (left to right) Jun Ma, Daniel Castro, and William Gomez.



Seven teams took part in the SAE Detroit Section’s Student Exhibit Competition sponsored by Eaton.

A senior mechanical engineering major, Castro was one of three SAE UPRM members who set up and manned the chapter’s booth as part of the SAE Detroit Section’s annual Student Exhibit Competition to which are invited all SAE Collegiate Design Series (CDS) teams. The booths were to incorporate the SAE Congress theme, “Leading Mobility Innovation,” and teams were required to make a formal presentation. In the presentations, teams had to show how they used an SAE specification in one or more of their CDS vehicles. Community involvement was another judging criterion.

“Our collegiate chapter and CDS teams have demonstrated the value of SAE,” said Castro. “By continuously participating in community service events and the CDS, our chapter has grown to be the most important, and most successful, engineering organization on campus. The mechanical engineering department chair, the industrial engineering department chair, and the engineering dean have expressed their intentions to continue supporting SAE as one of the best student organizations on campus to develop students into future professionals.”

Finishing second in the Student Exhibit Competition was the **Milwaukee School of Engineering**, and placing third was the **University of Wisconsin**. ■

TAKING ACTION EARLY TO CONQUER THE STEM CRISIS

Interest in STEM subjects falls precipitously as students progress through elementary and middle school.

By Patrick Ponticel, *MOMENTUM* Editor



A team of middle-school girls watches its motorized toy car ascend an incline as part of the Motorized Toy Car Challenge held during the SAE 2015 World Congress in Detroit.

In the offensive to help develop a more technically skilled workforce, SAE International often finds itself charging up a hill to gain ground. It recently charged up Capitol Hill to convey urgency about the imperative of planting positive notions about STEM (science, technology engineering, and math) in the impressionable minds of the nation's young school-goers.

"If you try to get to students interested in STEM at high school, it's too late. If you try to get them at college, it's too late," Christopher Ciuca, SAE's Manager of Pre-Professional Programs, said at a congressional briefing on June 15 as part of the Capitol Hill Maker Faire. Getting more kids interested in STEM is a job that must be done in middle school—or, even better, elementary school.

The falloff in STEM interest occurs very early in a child's education.

Ciuca noted that a third of students have lost interest in science by 4th grade. By 8th grade the percentage climbs to half. Things only get worse from there, with only 32% of high-school graduates qualified to attend a four-year college—and that's counting those who aren't interested in STEM.

Those already-sobering statistics look even sadder when measured against statistics from the other side of the supply-demand equation; the shortage of highly skilled workers in the U.S. is expected to grow to 3 million by 2018, according to Ciuca.

SAE is doing its part to reverse those trend lines. One of its key weapons is AWIM (A World In Motion), which is a widely used and praised curriculum for primary, elementary, and middle schools in the United States. The 11 distinct AWIM "challenges" feature fun and interesting hands-on activities that require an understanding of certain fundamental science and math principles.

This year marks AWIM's 25th anniversary. More than 17,000 schools and 4.5 million children have benefited from an AWIM curriculum over that time. And, it's not only kids. Teachers are benefiting from AWIM as well.

Those benefits to improve STEM instruction and teacher readiness overall have been quantified. According to a third-party longitudinal study, 80% of teachers who deliver AWIM at least once felt more knowledgeable and comfortable teaching physical science concepts. The success story continues, justifying learning for students.

For many students and teachers, the AWIM activity is a life-changing experience, said Ciuca: "Nobody remembers the day that they learned to multiply fractions in school. If you do, you probably remarked 'when am I ever going to really use this stuff...' But if we do the



Each of the 11 AWIM challenges comes with a kit and a classroom curriculum that go hand in hand. Shown is a kit that's part of the Motorized Toy Car challenge, which offers a particularly effective and memorable way for students to correlate classroom instruction about fractions to real-world applications such as gear ratios. SAE supplies one master kit for the teacher and nine regular kits for the students to share in teams.

AWIM Motorized Toy Car Challenge and we talk about gear ratios and we multiply fractions in the context of things like gear ratios and speed vs. torque, now all of a sudden we have a memorable and meaningful experience. Five years from now a student might think back to that particular experience and say, ‘That was the game-changer for me.’”

It’s not just the hands-on nature of the AWIM challenges that makes them effective. That’s a big part of the picture, but it’s the integration of hands-on activities with classroom instruction that really turbocharges AWIM. Under the program, students are first taught fundamental science and math concepts in the classroom, and then they apply that knowledge to design and build their AWIM projects. The hands-on activity reinforces what was learned in the classroom, according to Ciuca.

Many schools unwittingly short-circuit the connection between classroom instruction and hands-on activity. For example, some schools hold science fairs but do not require that the chosen projects relate to anything that was taught in the classroom—or, perhaps more importantly, do not require any basic understanding of the phenomenon they are displaying. Ciuca cites the example of batteries. For a science fair, a student could demonstrate in an interesting and entertaining way how a battery at room temperature performs better than a chilled one. But unless he or she has an understanding of why there’s a delta in performance, not much is being learned beyond the gee-wiz realization that temperature might affect battery performance.

“We’re making huge strides with AWIM helping teachers deliver relevant STEM instruction in a meaningful way for kids,” said Ciuca. “SAE’s STEM programs make learning engaging and real for students. We’re



Students fine-tune their motorized toy car before putting it on the track.

not just doing ‘STEM Activities’ hoping to excite kids about future careers. We’re making systemic change in our partner schools—building the future of the mobility industry and beyond.” ■

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ENERGID ACTIVELY WORKING ON SIMULATION TECHNOLOGIES FOR LUNAR AND PLANETARY ROVERS

For obvious reasons, conditions on lunar and planetary surfaces can understandably be hard to duplicate physically, even in the best case when they are “well understood,” if only from a distance. This makes digital simulations an essential tool during mission planning and development. Simulation can be used to study the effects of changes in terrain, lighting, reflectance, and other environmental factors on mission success.

In a typical space mission, though, many conditions are poorly understood. There may, for example, be limited understanding of soil—or regolith—properties before contact on a lunar mission. Addressing this requires special conceptual and mathematical tools. Parameters must be randomized to capture potential outcomes, and results must be optimized to discover the corner cases and unexpected outcomes that could impact a mission. **Energid Technologies Corp.** has been funded by NASA to develop a new robot simulation that accommodates uncertainty and discovers exceptional behaviors during mission planning.

“Our approach is to apply concepts from game theory and stochastic optimization to deeply simulate NASA’s robotic missions,” said Ryan Penning, Project Manager on the program. “The result will be a breakthrough ability to reason about uncertain environments and understand the extremes of what a robot can do.” Energid Technologies specializes in the control, simulation, and sensing of complex systems for the aerospace, agriculture, transportation, defense, and medical industries.

Energid, through its Actin software, brings enabling tools and capability to the project. Actin supports randomizing simulations of all types of robotic systems. It has physics-based models for articulated dynamics, contact dynamics, sensor simulation, and communications. In this effort, Actin, and its stochastic simulation capability, will be extended to



Actin provides powerful tools for camera, lidar, radar, and other sensors on all types of robots, from oil exploration to collaborative manufacturing, according to James English, CTO at Energid. The project with NASA will enable high-fidelity extensions for space environments and focus primarily on NASA’s KREX platform.

specialize this capability for new **NASA** space applications.

Some of Actin’s characteristics that make it particularly suited for such applications feature its automated reaction to dynamic workspaces, including collision avoidance; finely scripted velocity profiles of manipulated objects; and complex dexterous manipulation. Actin is built on what Energid says is an “industry-leading” proprietary optimization code that enables the robots that it controls to run some of the most challenging tasks in robotics today, all within a drag-and-drop interface.

Actin will be tailored to the space environment by modeling lunar regolith with highly parallelized particle models implemented on graphical processing units (GPUs). GPUs allow execution of high-fidelity simulation in real time on common computer hardware. Actin will also be tailored to support the appearance of lunar and planetary surfaces. This will allow high-fidelity simulation of cameras and other sensors.

“Actin already provides powerful tools

for camera, lidar, radar, and other sensors on all types of robots, from oil exploration to collaborative manufacturing,” said James English, CTO at Energid. “This project will enable high-fidelity extensions for space environments.” English told *Aerospace Engineering* that the work will focus primarily on NASA’s KREX platform.

The technology will be further commercialized by applying it to configure robotic systems and workcells on Earth. There is a pressing need for easier robotic programming to lower costs and empower people and businesses untrained in robotics but familiar with application domains where robots can contribute.

“Much of the cost of applying robots lies in configuring environments and workcells,” said Neil Tardella, CEO at Energid. “The prediction and simulation technology developed under this project will lower the cost of fielding robots and expand their application.”

Work on the project will be done in Wisconsin and Massachusetts.

By Jean L. Broge, *Aerospace Engineering*

BLIZZARD CONDITIONS TEST FCA'S 4WD AND AWD VEHICLES

With more 4x4 and all-wheel-drive vehicles in its product portfolio than at any other time, **Fiat Chrysler Automobiles** has invested \$2.5 million to upgrade a climatic test cell with a 4x4 dynamometer.

It is the first FCA test chamber in the U.S. with snow-making capability and a 4x4/AWD dyno.

"This is a must-have for testing purposes, especially with a large percentage of our Jeeps being 4WD and our large cars having an all-wheel-drive option," said Pete Jonko, Drive Cell Operations Engineer responsible for FCA North America's thermal drive cells.

Capability to power all four wheels is available in more than half of FCA's U.S. product lineup, including the 2015 Renegade, **Jeep's** first compact SUV, and the 500X, Fiat's first AWD vehicle since the brand's U.S. relaunch in MY2012.

Jonko and other technical specialists spoke with *Automotive Engineering* at the recent opening of the new facility, part of FCA's 5.4 million ft² Auburn Hills, Mich., Chrysler Technology Center (CTC).

Kumar Srinivasan, Manager of the CTC's Computational Fluid Dynamics Group, likes the convenience of a three-minute walk from the CFD group's work area to the new 4x4 dynamometer cold test cell.

"The close proximity of this drive cell helps us to understand very quickly how a vehicle is performing under blizzard-like conditions," he said. "We can then go back and fine-tune or update our simulation models to more closely match what's actually going on with the air intake system and other vehicle subsystems."

The climatic drive cell's front dynamometer can handle loads of up to 350 hp (261 kW) while the rear dyno can operate up to 650 hp (485 kW)—a significant upgrade versus the test cell's previous 200 hp (149 kW) and 2WD capability. Substantial ductwork revisions and exhaust alterations enable the new dyno to accommodate high input torque levels from vehicles such as the 2016 Ram 2500 and its 6.7-L Cummins turbodiesel.

ICE-powered vehicles as well as hybrid-electric and all-electric vehicles have already endured the cell's frosty climes, which range down to -40° F (-40° C). Wind speeds up to 100 mph (62 kph) are also available, according to Jonko.

"This is the tech center's most capable dyno in terms of horsepower and vehicle exhaust management," he noted, adding

AWD cars that's not always possible."

He said sometimes an AWD conversion meant unplugging wheel sensors and front or rear power transfer units. As driveline technology progressed, the FCA testers found it increasingly difficult and time-consuming to run their AWD vehicles on the 2WD dyno.

In addition to the upgraded drive cell,



A 2015 Jeep Renegade Trailhawk grows an icy coat inside CTC's newly revamped climatic test chamber equipped with a 4x4 dynamometer.

that FCA's Chelsea (MI) Proving Grounds has the same dyno set-up, but it's limited to hot testing. The newly renovated CTC cell can be heated to 125° F (51.5° C).

Testing 4x4 vehicles on a purpose-designed dyno also eliminates preparation slowdowns, because every 4x4 vehicle previously slated for the climatic chamber had to be reconfigured as a 2WD variant.

"With an old style 4x4 you could pull the front propshaft from the differential and essentially run in a 2WD/rear-wheel drive mode," Jonko explained. "But with

CTC has two other thermal drivability cells, three static hot/cold cells, and four conditioning/soak cells on its environmental test chamber roster.

By Kami Buchholz, Automotive Engineering

UNSTOPPABLE FORMULA- SAE TEAM LEADER EARNS RUMBAUGH AWARD



For SPSU's 2013-2014 Formula SAE racecar, team captain Tad Young designed the car's frame, drivetrain, pedal assembly, shifter steering, and fuel systems.

An uncertain product development budget didn't derail the **Southern Polytechnic State University** (SPSU)'s Formula SAE team from scoring the school's highest overall finish in more than a decade in this annual competition.

As SPSU's 2013-2014 team captain, Grady "Tad" Young kept the 22-person team on task designing and building a Formula One-inspired racecar despite their next-to-nothing finances.

"One month into the competition year we didn't even have enough funding to pay our competition fee. However, our continued work in the shop and support of our school showed our funding organization that we were not going to give up," said Young, who received **SAE International's** 2014 Rumbaugh Outstanding Student Leader Award for his efforts.

Established by a generous contribution from Max E. Rumbaugh Jr., Executive Vice President of SAE 1986-2001, this an-



Max E. Rumbaugh Jr. (right) and SAE President Richard W. Greaves present Grady "Tad" Young with the Rumbaugh Outstanding Student Leader Award on April 21 at the SAE 2015 World Congress in Detroit. "As part of the award, Rumbaugh personally accompanies the winner for three full days at the SAE Congress, which he did again at this year's event. The idea is to expose the young person to SAE's largest conference and to the inner workings of the organization, with the goal of inspiring each annual recipient to become an SAE leader during his/her adult career."

nual award recognizes SAE-related leadership activities.

"Tad was nominated and selected for his exceptional leadership and ability to motivate fellow students to achieve more than had ever been accomplished by his university in the Formula SAE Competition," Rumbaugh told *MOMENTUM*.

The indefatigable Young used CAD to create and optimize designs and plan for electrical and other component purchases, recalled the school's lead Formula SAE faculty advisor.

"When funding was finally released at a reduced rate close to competition time, he was prepared to move at a fast pace to get the car ready just in time," said Randy Emert, SPSU/**Kennesaw State University's** Formula SAE faculty advisor. Emert is KSU's assistant professor of mechanical engineering technology at the Marietta, GA, campus. (SPSU consolidated with KSU under the KSU banner in 2015.)

As a December 2014 graduate of SPSU with a bachelor's degree in mechanical engineering technology, Young gained valuable lessons from participating in Formula SAE. "My biggest two leadership lessons were to lead by example and to always expect the worse, but aim for the best," he said.

Young plans to communicate regularly with the Collegiate Design Board at SAE. "Having just graduated, I am still very close with the Formula SAE team. I would like to help improve the school's Formula SAE program and the retention rate for SAE membership with Formula SAE graduates as much as possible," Young said.

To read an extended version of this article, go to <http://articles.sae.org/14138/>. ■

This article is based largely on reporting by Kami Buchholz for *Automotive Engineering*.

GIVE A PRESENTATION AT THE SAE 2016 WORLD CONGRESS



Among the college students giving presentations at the SAE 2015 World Congress earlier this year were Katherine Bovee, a third-year Ph.D. student in mechanical engineering at Ohio State, and Chris D. Monaco, a second-year graduate student seeking a master's degree in mechanical engineering at Penn State.

Technical papers and presentations in the areas of automotive electronics, safety, powertrain, materials, emissions, and propulsion are being sought for the **SAE International's** 2016 World Congress and Exhibition slated for April 12-14, 2016, in Detroit.

This opportunity is offered to students as well as professionals. But time is running short. Submit an abstract of about 300 words to Nori. Fought@sae.org for consideration into the program.

Executive Leadership for the SAE 2016 World Congress is being provided by **Toyota**. The Tier One Strategic Partner is **AISIN**. Various industry experts, management teams, engineers, and executives alike gather to collaborate and address current challenges, seek new windows for discovery and exploration, and promote the multitude of opportunities fundamental for a successful future.

The SAE 2016 World Congress features the theme "Powering Possibilities," which represents a world of untapped discoveries in the automotive industry. For more information on the SAE 2016 World Congress and Exhibition, visit <http://www.sae.org/congress/>. ■

DOUG GORE REMEMBERED FOR SAE VOLUNTEERISM



Photo of Doug Gore and Siddarth Kashyap at Formula Hybrid 2012, posted to the FSAE Facebook page (<https://www.facebook.com/FormulasAE>) by the latter.

SAE International recognizes the passing of Doug Gore on May 27, 2015. An SAE member for the past 22 years, he was a design judge at Formula SAE since 1995 and served in the same capacity at various other SAE and non-SAE student competitions.

Doug was known for spending time discussing vehicle design and mentoring the engineering students who produced them. Doug interfaced well with the student competitors. He was always patient, and was a good listener, but he was also really good at telling stories and freely imparting his wisdom to anyone willing to drink from the firehose. The knowledge exchange went both directions. Doug was heard frequently saying: "These are amazingly talented students. I learn something every time I go to a Formula SAE competition."

A motorsports enthusiast, Doug not only drove racecars but also developed safety improvements for them. He served as Senior Technical Editor for *Stock Car Racing* magazine, *Open Wheel* magazine, and *Speedway Illustrated*.

Doug was often called on by many in the motorsports industry as a consultant for a new part design or improvement. Doug formed Gore Engineering in 1989, and did contract engineering work for a wide range of clients, including testifying as an expert witness in various legal actions. ■

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UE ROLL, the latest member of the Ultimate Ears family of rugged mobile speakers from **Logitech**, is a powerful pint-sized wireless Bluetooth speaker that is built for adventure. It's shockproof and IPX7-waterproof, so you can dunk, drop, or toss it anywhere without worry. With a 9-h battery life, 65-ft (20-m) wireless range, and awesome 360° sound, this speaker is made for your ultra-mobile life-style. And, it comes equipped with a marine-grade bungee cord so you can hang the speaker from anything or strap it to anything—from bike to swimsuit to showerhead, so you can enjoy music anywhere you go. Through the UE ROLL app for iOS and Android, you can wake up to your favorite music, remotely turn the speaker on, and even double the sound by pairing it with any other Ultimate Ears speaker. The suggested retail selling price is \$99.99.



THINNER AND LIGHTER TABLET

Microsoft recently introduced a new Surface, the Surface 3. Like Surface Pro 3, it's a tablet that can replace your laptop but is thinner, lighter, and even more affordable. Surface 3 is optimized to run full Windows and Office and features long battery life. The ability to run Windows apps and the versatile pen experience—great for taking notes or marking documents—make Surface 3 ideal for students, schools, and anyone looking for a portable device to get things done. Starting at just \$499, Surface 3 comes complete with a one-year subscription of Microsoft Office 365 Personal, including Outlook, Word, Excel, PowerPoint, and OneNote, plus OneDrive cloud storage. It is powered by the new quad-core **Intel** Atom x7 processor, so it is quick and responsive but designed to maximize efficiency with up to 10 h of video-playback battery life.



SMARTPEN APP GOES GLOBAL WITH ANDROID

Livescribe Inc. has launched the Android version of the Livescribe+ app globally, opening up the Livescribe 3 smartpen to millions of Android smartphone and tablet owners. Android users can start digitizing, searching,



and sharing their hand-written notes by picking up a Livescribe 3 smartpen and downloading the Livescribe+ app, free on the **Google** Play store. Initially launched for iOS, Livescribe+ for Android has been optimized for Android by incorporating Google's Material Design guidelines to introduce a unique Android approach to the app's core functions and user experience. One Livescribe 3 smartpen can sync with up to four iOS and Android devices. The Livescribe 3 smartpen is available for \$149.95 (or \$199.95 for the Pro edition).

PORTABLE STORAGE

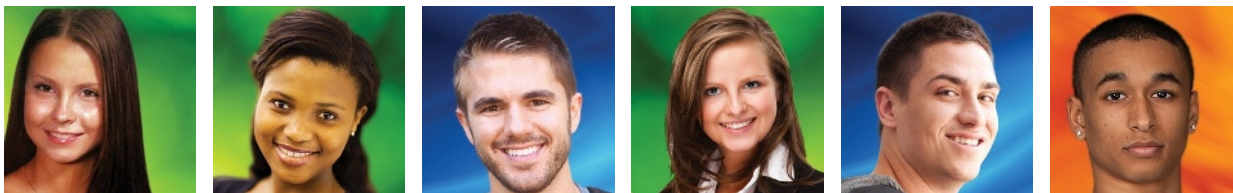
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Toll-free: +1.877.606.7323 (U.S. and Canada)

Phone: +1.724.776.4970 (Outside U.S. & Canada)

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RECOGNIZE MOBILITY ENGINEERING STUDENTS & EDUCATORS

Nominate an outstanding student, young engineer, or educator for the following SAE Awards:

Excellence in Engineering Education - Triple “E” Award

September 30 deadline

This award recognizes outstanding contributions made by an individual toward activities related to the SAE Education Board. Learn more and submit your nomination: <http://awards.sae.org/eee/>

Franz F. Pischinger Powertrain Innovation Award

October 15 deadline

The award recognizes a member with exceptional innovation and competence in powertrain design and development. Learn more and submit your nomination: <http://awards.sae.org/pischinger/>

Gary Dickinson Award for Teaching Excellence

October 30 Deadline

This award recognizes an outstanding middle school teacher or teachers who have creatively utilized the A World in Motion (AWIM) program. Learn more and submit your nomination: <http://awards.sae.org/dickinson/>

Heinz C Prechter Award for Automotive Engineering

October 31 Deadline

The award provides funds to a young entrepreneur in the automotive industry. Learn more and submit your nomination: <http://awards.sae.org/prechter/>

For the complete list of student awards, visit students.sae.org. PLUS, be sure to check out scholarship opportunities available to both undergraduate and graduate students - go to students.sae.org/scholarships for more information.

Find out more about the WISE (Washington Internships for Students of Engineering) Program.

December 31 deadline

The program seeks applications from outstanding engineering students who display evidence of leadership skills and have a keen interest in public policy.

Learn more and submit your nomination: <http://www.wise-intern.org/>

SAE values and appreciates the time you spend completing a nomination. If you need any assistance, please contact the SAE Awards staff at awards@sae.org, or SAE Customer Service at +1.877.606.7323 (U.S. and Canada only) or +1.724.776.4970 (outside U.S. and Canada).